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OILS FOR METAL CUTTING IN POLAND

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Oils for mechanical metal cutting can basically be divided into 2 groups. The first group includes mineral oils with the addition of grease or oils containing dissolved sulfur; the second group consists of water-soluble oils; they contain mineral oil with dissolved resin, naphthene, or fatty soaps, and are homogenized by the addition of alcohol glycerine, or other additives. Pastes for metal cutting should also be included in the second group; these contain fatty soaps thickened in mineral oil, with the addition of water. The oils and pastes belonging to the second group form stable emulsions when mixed with water.

Oils for metal cutting serve the purpose of not only lubricating cut parts and cutting tools, but they must also absorb the heat generated by friction during the process. The application of compressed air and of pure water as a cooling medium has very limited application.

Oils for metal cutting must meet the following requirements:

1. The oil must lubricate the tools and the materials so as to reduce heat and friction, to preserve the tools, and to save on the expenditure of power.

2. The oil must protect the tools and materials from corrosion.

3. The oil must prevent any changes in color of the metal being cut.

4. The oil must not generate smoke during the work.

5. The oil must not have a disagreeable odor.

6. The water emulsion formed by the oil must be stable for a fairly long period of time, i.e., the emulsion must not separate into layers.

7. The cooling liquids should not attack the skin of the person who is servicing the metal cutting machine.

A fat-containing oil or its water emulsion is chosen for work, depending on the type of machine and on the specific working conditions. If cooling is a major factor, a water emulsion should be used. Under heavy working conditions, where good lubrication is essential, the fatty oil should be used, or alternately the oil and its water emulsion. If the fatty oils do not contain fats which tend to turn rancid rapidly, and if fresh oil is added frequently during the operations, the oils should meet the necessary requirements for fairly long time periods. Oils used in water emulsions must be properly selected and prepared, if they are to fulfill their purpose. In preparing the emulsions, the oils should always be added to the water, rather than the other way around, and the mixture should be stirred continuously. The temperature of the components should be no lower than 10 degrees Centigrade, and no higher than 30 degrees Centigrade. It is advisable to prepare ahead of time a concentrated oil-water solution in a ratio of 1:5 or 1:10, which then facilitates the preparation of the specific emulsions needed for particular cutting operations. In this case, it is immaterial whether the solution is added to the water or the water to the solution. The concentration of the

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emulsion should be adapted to the requirements of the working conditions and to the type of metal to be cut.

Good performances can be expected from an emulsion only if it is protected from impurities, such as dust, solid lubricants, oil, chemicals, and particularly from excessive amounts of metal filings. A contaminated emulsion is very unstable. Its path of circulation should therefore be cleaned periodically, and the emulsion itself should be filtered to remove impurities. In the case of heavy cutting, the tools tend to heat up excessively, which causes the emulsion to thicken through gradual evaporation of the water. The oil will then adhere to shavings or filings, thus gradually depleting the emulsion and rendering it unstable, which may ultimately lead to corrosion of the metal parts. For this reason, the oil contents of the emulsion should be tested periodically.

The oil content is determined as follows: 100 ml of the emulsion is poured into a glass flask with a capacity of about 130 ml; the flask should have a narrowed neck calibrated from 0 to 15 ml at 0.1 ml intervals, and a ground glass stopper; a prepared mixture made up of 100 g of concentrated sulphuric acid, 100 g of table salt, and 800 g of water is added to the emulsion, filling the flask up to the upper mark; the contents are mixed by shaking the flask, and the latter is placed in a water bath at a temperature of 60 to 80 degrees Centigrade for about 30 minutes; after the separated oil clears completely, the flask is removed from the bath and cooled, and the amount of separated oil is read off in milliliters. This amount equals the percentage of oil in the given emulsion. The table salt contained in the above mixture helps to speed up the process of separation. If the test shows that the ratio of oil to water is inappropriate, this should be corrected by adding either one or the other.

The test described above may also serve to illustrate the negative effect of acid on the stability of an emulsion. If even a small amount of acid enters the circulating system, the emulsion breaks up completely. The stability of the emulsion also depends on the water used in its preparation, i.e., on its components and degree of hardness. As a rule, the hardness of the water used for this purpose should not exceed 8° "German". Water with a higher degree of hardness should be softened to a level of 6 to 8° before use. The water should not be softened to a level approaching 0°, since this produces foaming of the emulsion during circulation. Among the substances used for softening water are ammoniated soda ash, hydrated crystalline soda, and sodium triphosphate.

Sodium triphosphate is the most effective of the above, since it precipitates all chemical compounds which cause hardness of water. In order to lower the hardness of 100 liters of water by one degree, 1.9 of ammoniated soda ash, 5.1 g of crystalline soda, or 5.0 g of sodium triphosphate are required. Thus, to lower the hardness of 200 liters of water from 16 to 6°, 38 g of ammoniated soda, 102 g of crystalline soda, or 100 g of sodium triphosphate should be used. Excessive amounts of chemicals should be avoided. The water softener is dissolved in a bucket of hot water, then added to the water to be softened, and stirred thoroughly. The solution is allowed to settle for several hours, or preferably overnight. The clear softened water may be used for making the emulsion, adhering to the rule that the oil must be poured into the water gradually, with constant stirring. Freshly prepared emulsions are alkaline, but tend to become acid during operation. Acid emulsions cause corrosion in addition to leading to the separation of the emulsion into water and oil. The pH of the emulsions must therefore be determined at frequent

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intervals. Emulsions with a pH range of 8 to 9 are used in cutting steel and iron; emulsions with a pH range of 7 to 8 are used in cutting aluminum and colored metals. The pH is determined by means of a pH-meter or by means of paper indicators which are dipped in the solution and compared with a color scale to determine the pH of the given solution. Acid emulsions should be alkalized by the addition of a water solution of soda, sodium hydroxide,or potssium hydroxide. The graph shown above may be used in determining the amounts of ammoniated soda to be used for obtaining the desired pH in the given emulsion.

Oils for metal cutting should be properly stored, since they are very susceptible to atmosphereic conditions. Under improper storage conditions, especially in the winter time, the emulsifiers may precipitate out of the oil, which leads to its separation into its components and makes it unsuitable for preparing water emulsions.

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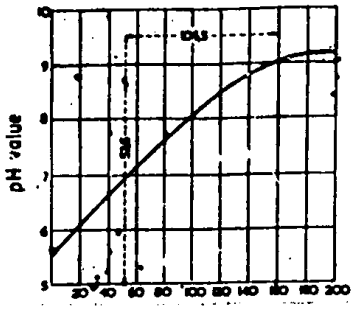

Example: pH confirmed 7.0, pH required 9.0, needed amount of soda: 160 - 53.5 = = 106.5 g/100 liters emulsions

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